

The Quad-Core AMD Opteron™ Processor

Quad-Core AMD Opteron™ Processor Launch

- 1** Changing the Game
- 2** Built for the Datacenter
- 3** Market Readiness
- 4** Conclusion

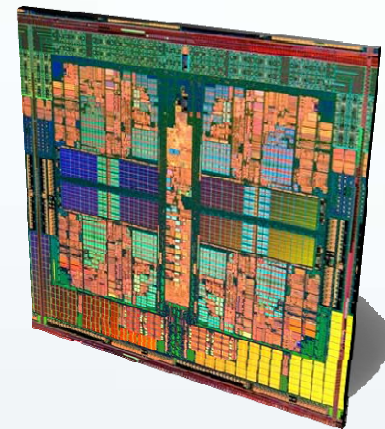
Introducing the new Quad-Core AMD Opteron™ Processor



Quad-Core AMD Opteron™ processors...
designed for the datacenter's most pressing challenges and priorities

Why the Quad-Core AMD Opteron processor changes the game :

- Most significant launch since AMD Opteron processors introduced in 2003
- Market is ready and hungry for the world's most advanced x86 processor
- Performance-per-watt leadership
- Showcases the most relevant datacenter innovations for energy-efficiency, virtualization, investment protection and performance



Quad-Core AMD Opteron™ Processor Highly Efficient at Launch...



Major
segments
of market
addressed
at launch

HE Energy Efficient

- Fastest growing market segment
- Rack-dense and blade environments
- Available at launch
- Up to 1.9 GHz at launch; higher in Q4/Q1

Standard Performance

- Main market segment
- Price/performance "sweet spot"
- Available at launch
- Up to 2.0 GHz at launch; higher in Q4

SE High Performance

- Niche market segment
- Performance above all other needs
- Planned for Q4 delivery
- Up to 2.5 GHz in Q4

...and Scaling To Higher Frequencies

Quad-Core AMD Opteron™ Processors



More than just four cores

- Significant CPU Core Enhancements
- Significant Cache Enhancements

Outstanding Performance

- Native Quad-Core
 - For faster data sharing between cores

Optimal Virtualization

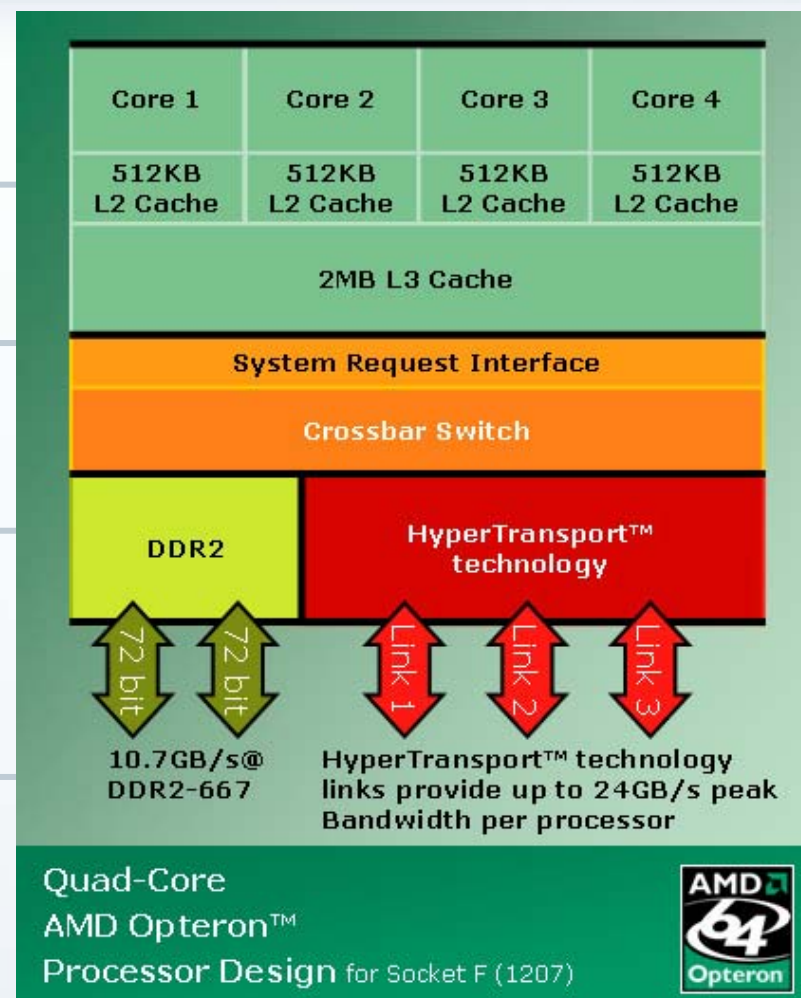
- AMD Virtualization™ technology
 - Now with Rapid Virtualization Indexing for virtual environments

Investment Protection

- Stable Platform
 - Socket F (1207) compatibility
 - Leverage existing platform infrastructures
 - Consistent thermal envelopes

Power Efficient

- Performance/Watt leadership
 - Performance enhancements without increased power consumption
 - Unique power management innovations



Quad-Core AMD Opteron™ Processor Production Overview



Jointly Developed

- 65nm technologies developed as part of IBM and AMD's Joint Development Agreement

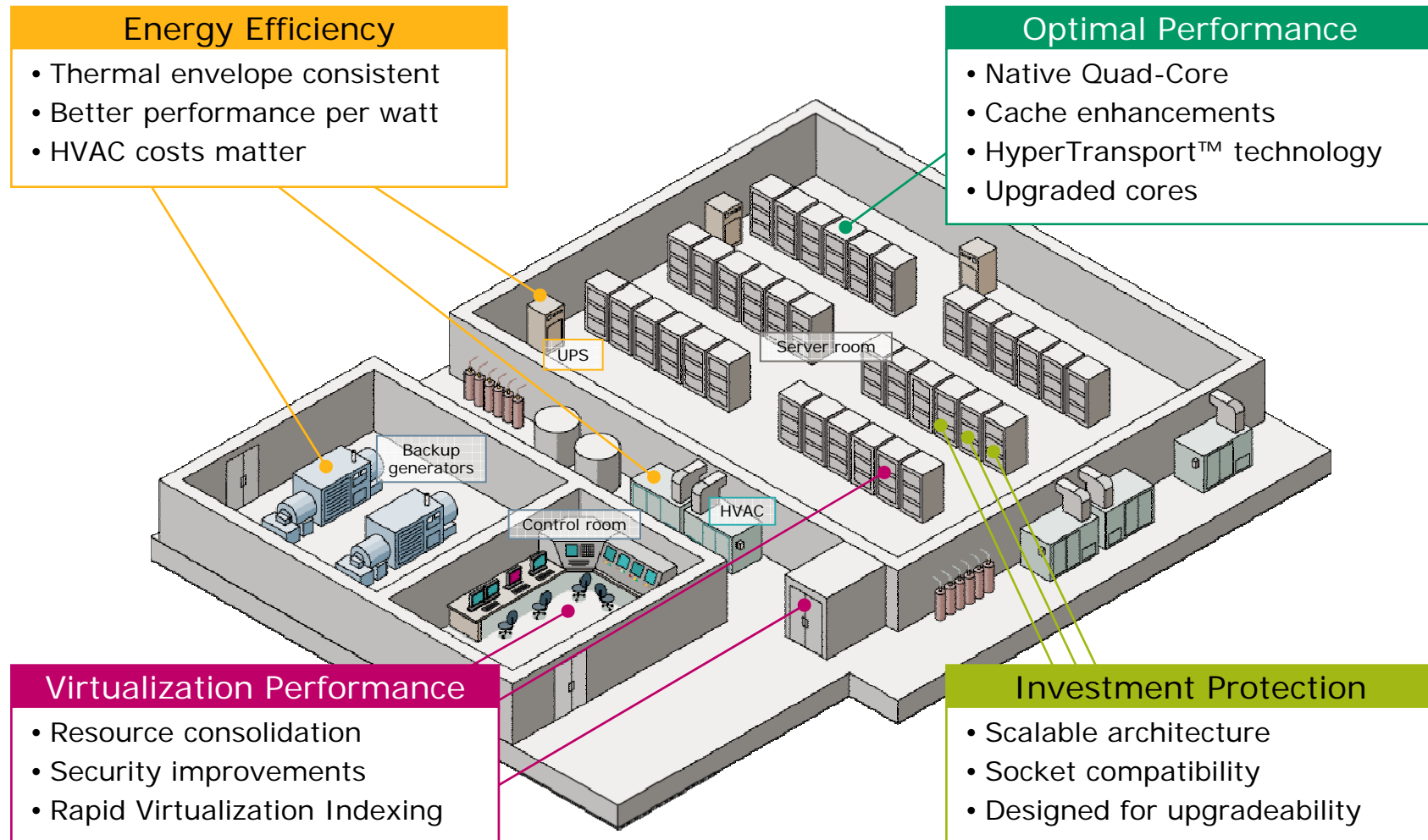
Rapidly Ramped

- Introduced in Fab 36
- 1000 wafer starts to reach mature yields

Successfully Delivered

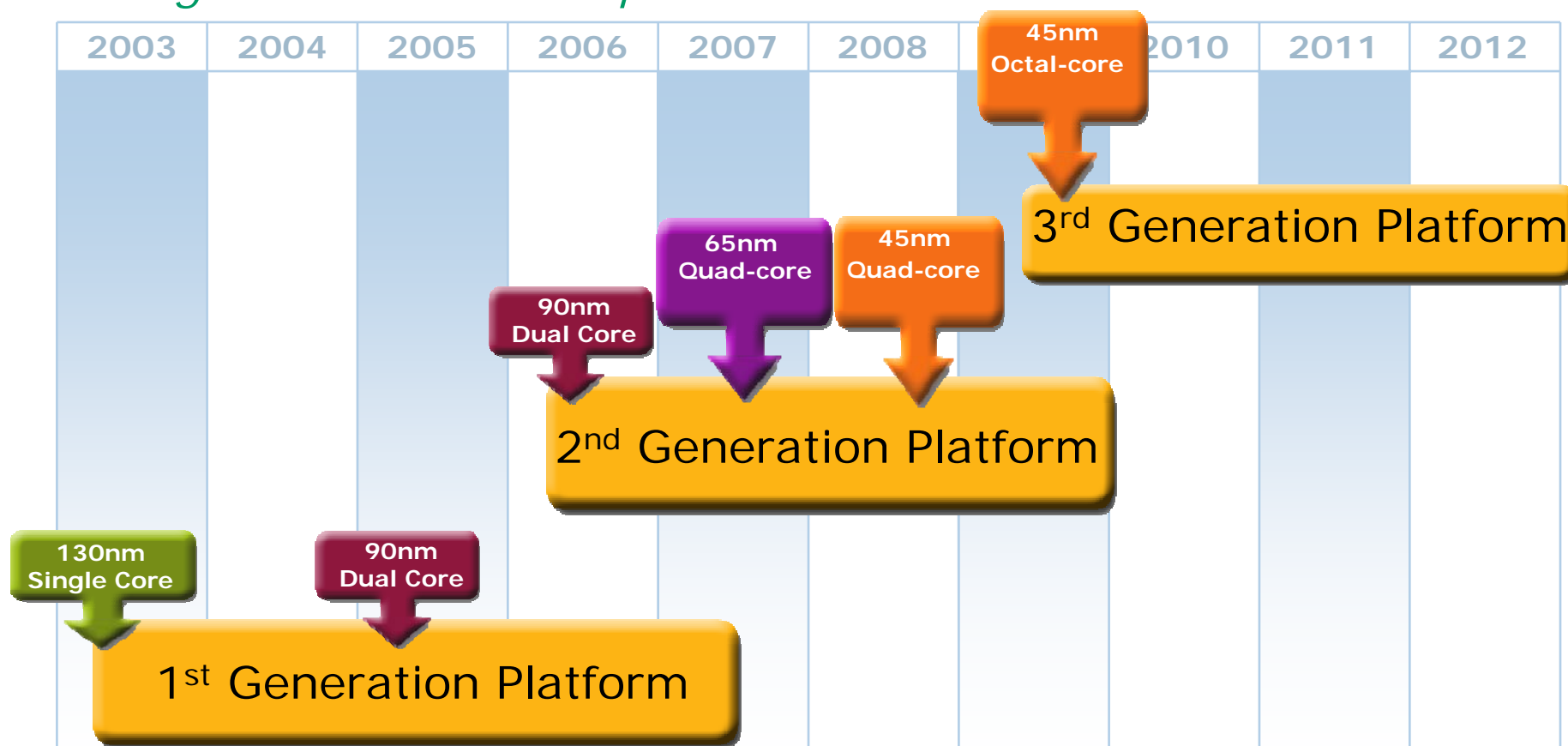
- First 65nm shipments to customers in December 2006
- Fab 36 is fully converted to 65nm production

Built for the Datacenter



Investment Protection: Stable Platform Progression

Long-term success for partners and end-customers

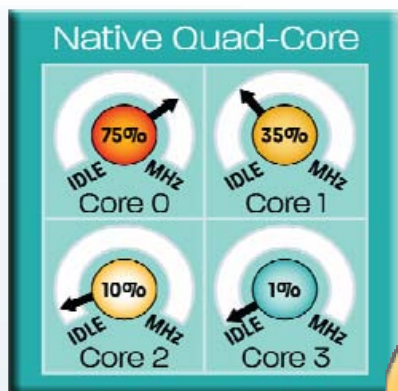


Stable platforms deliver better long-term value and logical transitions for partners and customers

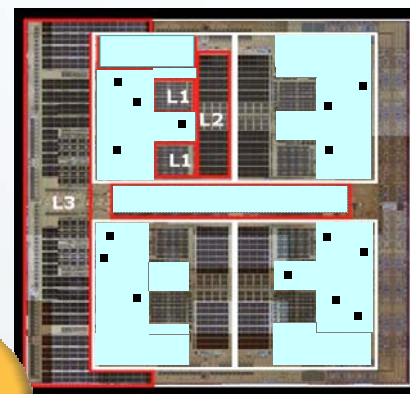
AMD Power Efficiency Innovation



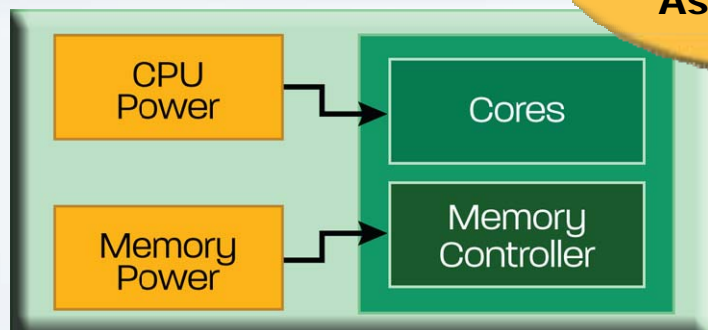
Independent Dynamic Core Technology



AMD CoolCore™ Technology



**Same Power
And Thermal Envelopes
As Dual-Core!**



Dual Dynamic Power Management™



Low-Power DDR2 Memory

Average CPU Power

Creating a more useful metric



Customers prefer a more accurate way to account for power than the engineering Thermal Design Power (TDP)

AMD Opteron™ processor TDP represents theoretical limits

- TDP methodologies differ between manufacturers
- Not representative of “real world” peak work loads

Over-estimating power budgets can lead to wasted data center space and inefficiencies

**AMD has defined a new metric for a more useful way to evaluate processor power consumption -
Average CPU Power (ACP)**

Introducing Average CPU Power

Average CPU Power (ACP) - Measuring processor power draw on all CPU power rails while running accurate and relevant commercially useful high utilization workloads*

ACP	TDP
105W	120W

ACP	TDP
75W	95W

ACP	TDP
55W	68W

Each ACP value includes power for Cores, Memory Controller, and HyperTransport™ links

ACP values are considerably lower than TDP

- Because AMD's TDP values are conservative engineering design limits
- ACP includes workloads such as TPC-C, SPECcpu2006, SPECjbb2005, STREAM

TDP will continue to be leveraged for engineering thermal design maximum limits

Overall platform power is most important

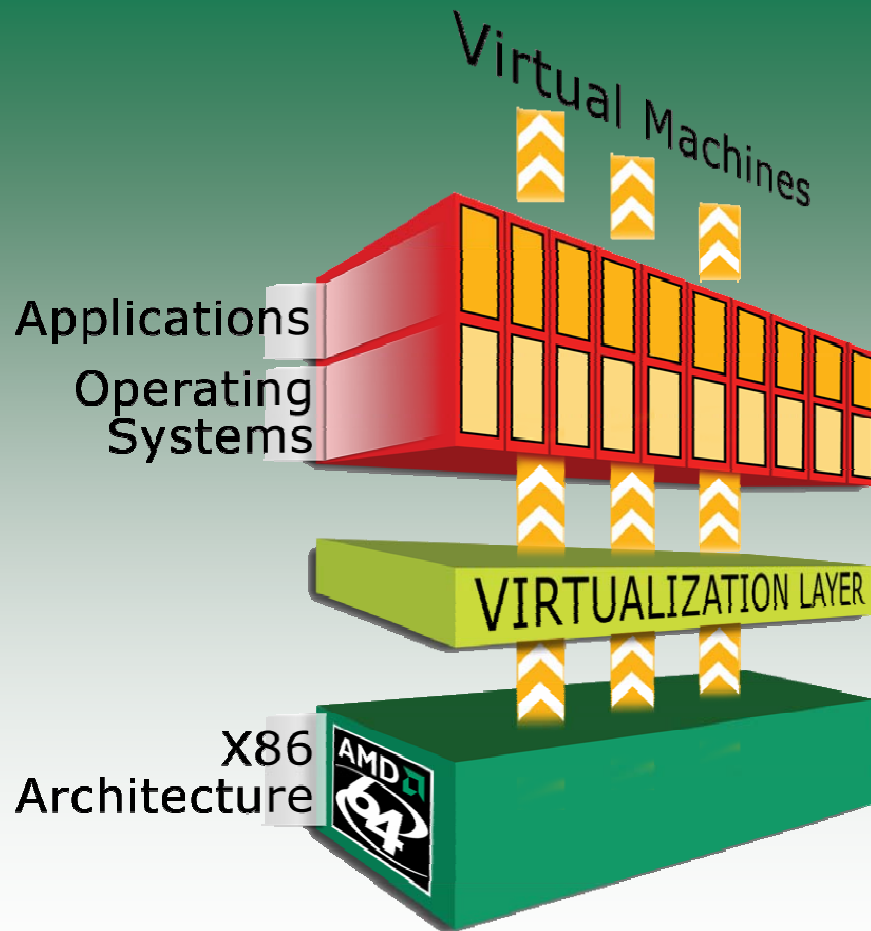
Enabling New Levels of Virtualization Performance



"We see multi-core capabilities in the Quad-Core AMD Opteron™ processor as a perfect fit for virtualization. The Rapid Virtualization Indexing feature of AMD's Direct Connect Architecture takes this combination to the next level, smoothing out the performance profile of the most demanding workloads."

Dr. Steve Herrod, vice president, Technology Development, VMWARE

AMD Virtualization™ Technology Leadership



Performance

- Direct Connect Architecture
- **Introducing: Rapid Virtualization Indexing**

Security

- Device Exclusion Vector

Software Support

- AMD-V™
- Live Migration
- 64-bit Guest OS Support

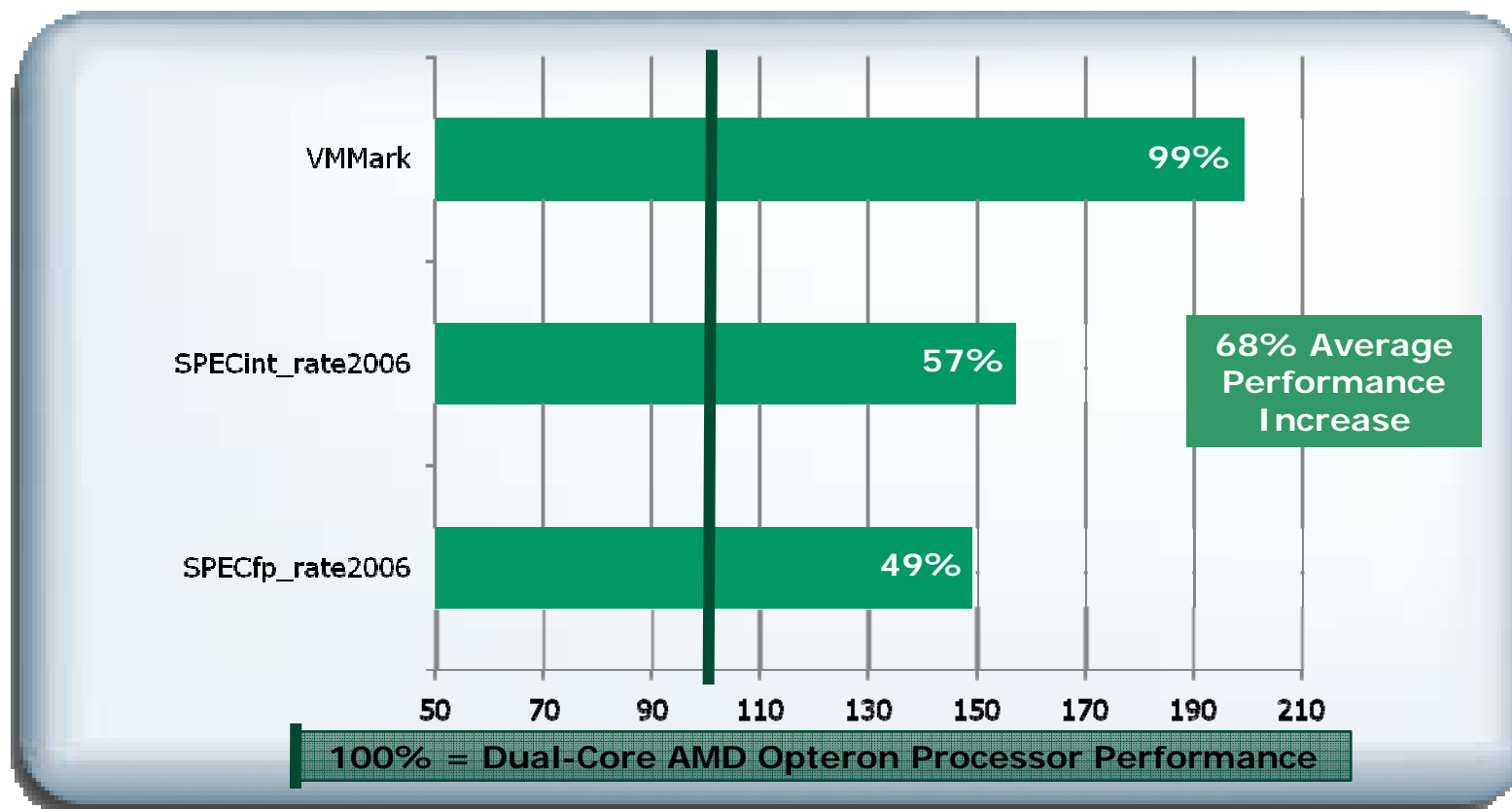
Expected 2009 Enhancements

- IOMMU for Security and Performance

Dual-Core to Quad-Core Uplift



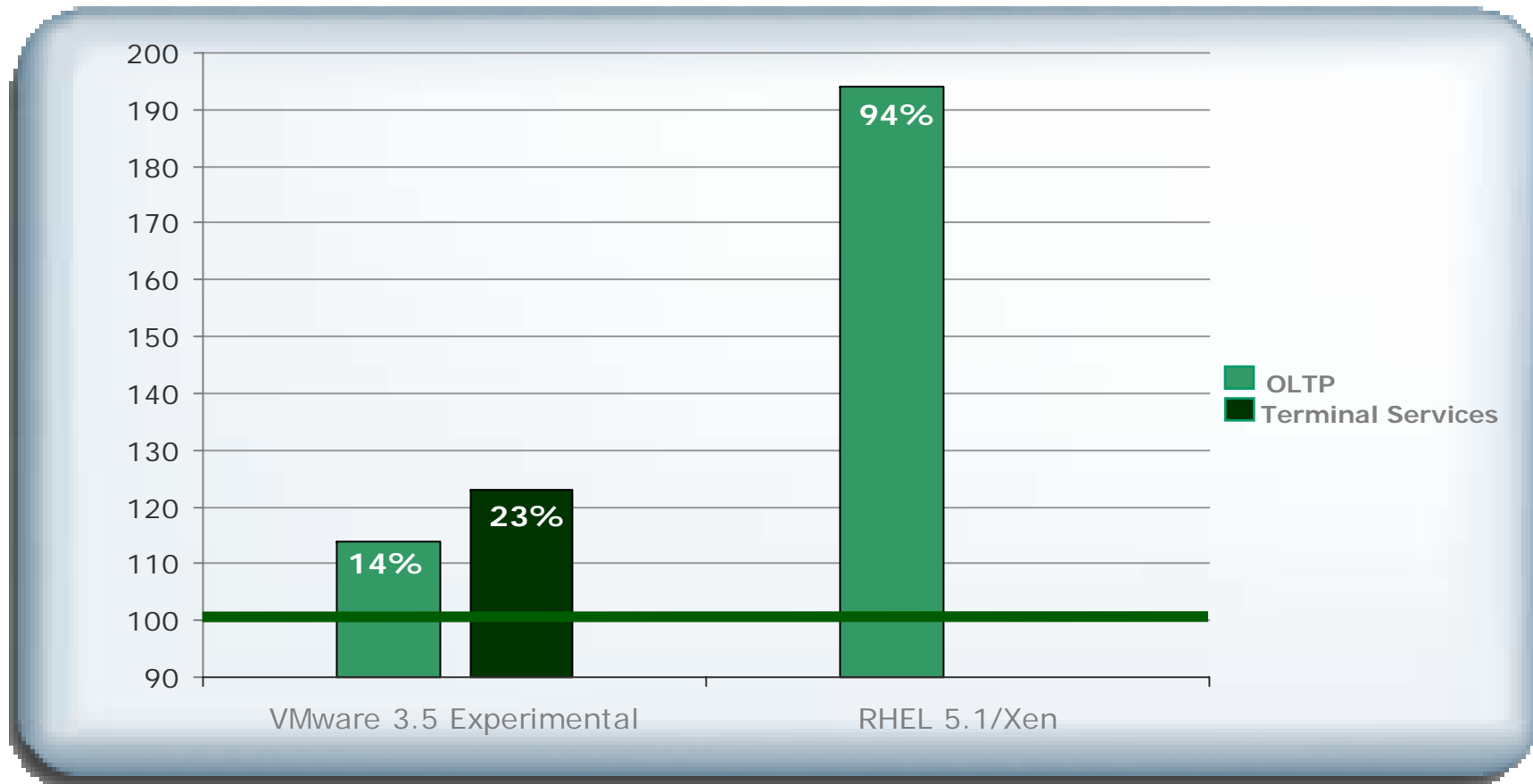
Dual-Core AMD Opteron™ 2200 Series vs. Quad-Core AMD Opteron Model 2350 2 Socket Performance Scaling



SPEC and the benchmark name SPECint and SPECfp are registered trademarks of the Standard Performance Evaluation Corporation. Benchmark results stated above for Dual-Core AMD Opteron™ processor Model 2222 reflect results published on www.spec.org as of Sep 9, 2007. The comparison presented above is based on results for Quad-Core AMD Opteron processor Model 2350 under submission to SPEC as of Sep 9, 2007. For the latest results visit <http://www.spec.org/cpu2006/results/> and <http://www.spec.org/omp/results/>. Stream and VMmark results based on internal measurements at AMD performance labs.

Rapid Virtualization Indexing Uplift

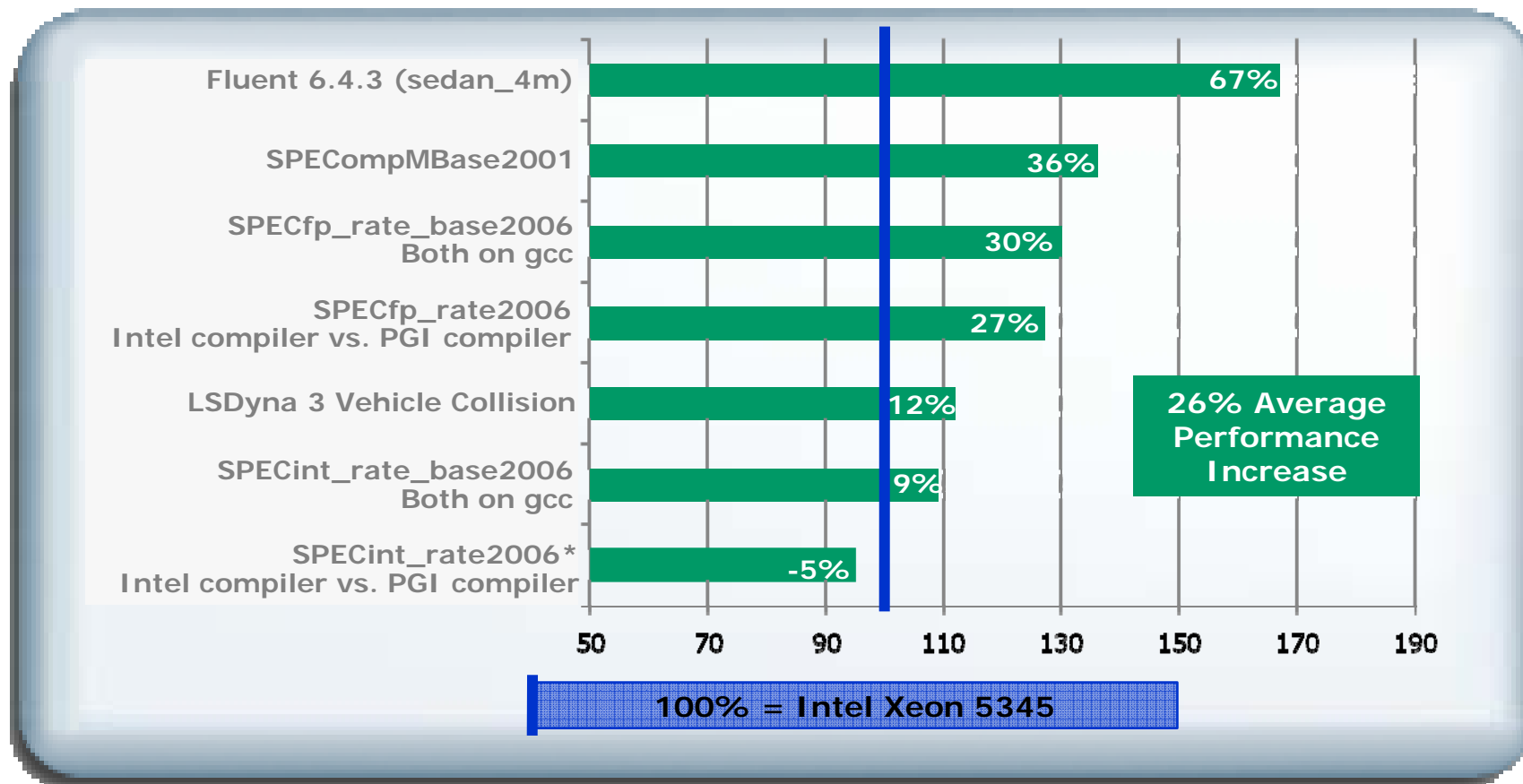
Quad-Core AMD Opteron™ Processor Model 2350



100% = Without Rapid Virtualization Indexing

Performance-Per-Watt Leadership

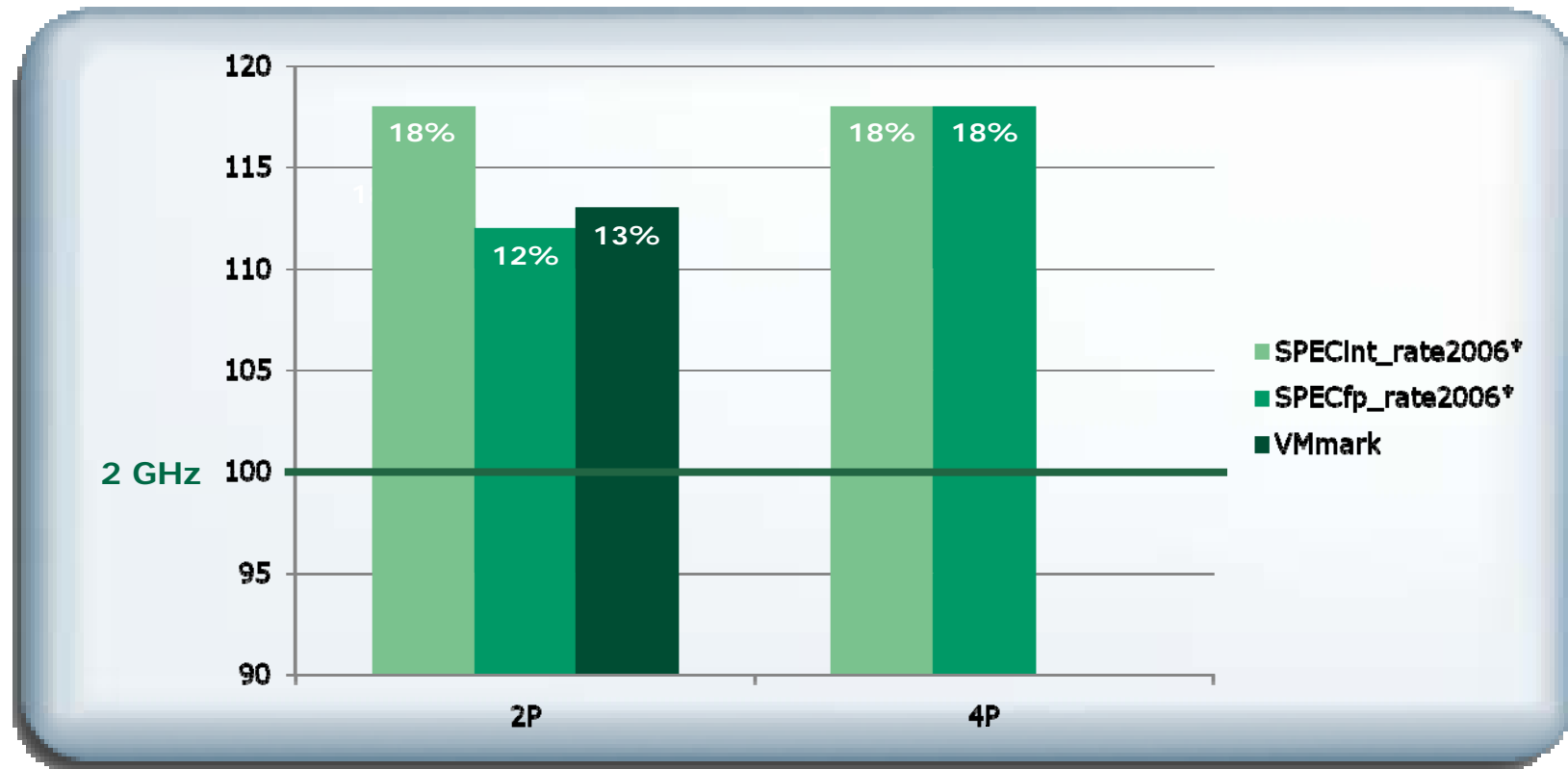
Quad-Core AMD Opteron™ Processor Model 2350 (75 Watt) vs. Intel Xeon 5345 (80 Watt, without Additional Watts of Memory Controller and FBDIMM)



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Quad-Core Frequency Scaling

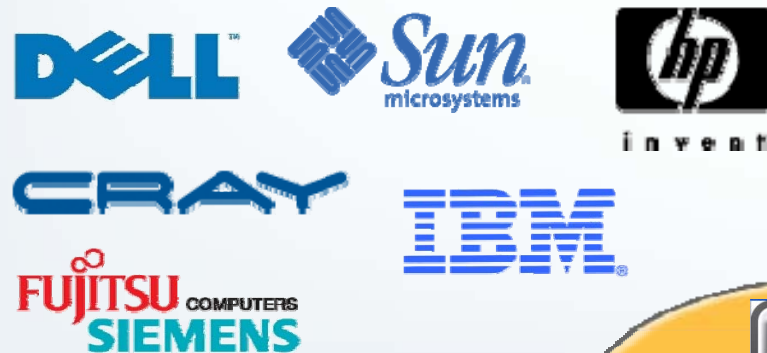
Quad-Core AMD Opteron™ Processor Model 2360 SE (2.5 GHz) vs. Model 2350 (2 GHz)



SPEC and the benchmark name SPECint and SPECfp are registered trademarks of the Standard Performance Evaluation Corporation. The comparison presented above is based on results for Quad-Core AMD Opteron™ processor Model 2350, Model 2360 SE, Model 8350, and Model 8360 SE under submission to SPEC as of Sep 9, 2007. For the latest results visit <http://www.spec.org/cpu2006/results/>. VMark based on internal measurements at AMD performance labs.

Expanding Ecosystem

Leading OEM Platforms...



...regional choices...



...the best in software partners...



...and integration partners to put it all together

Platforms in Market Today

2003 vs.

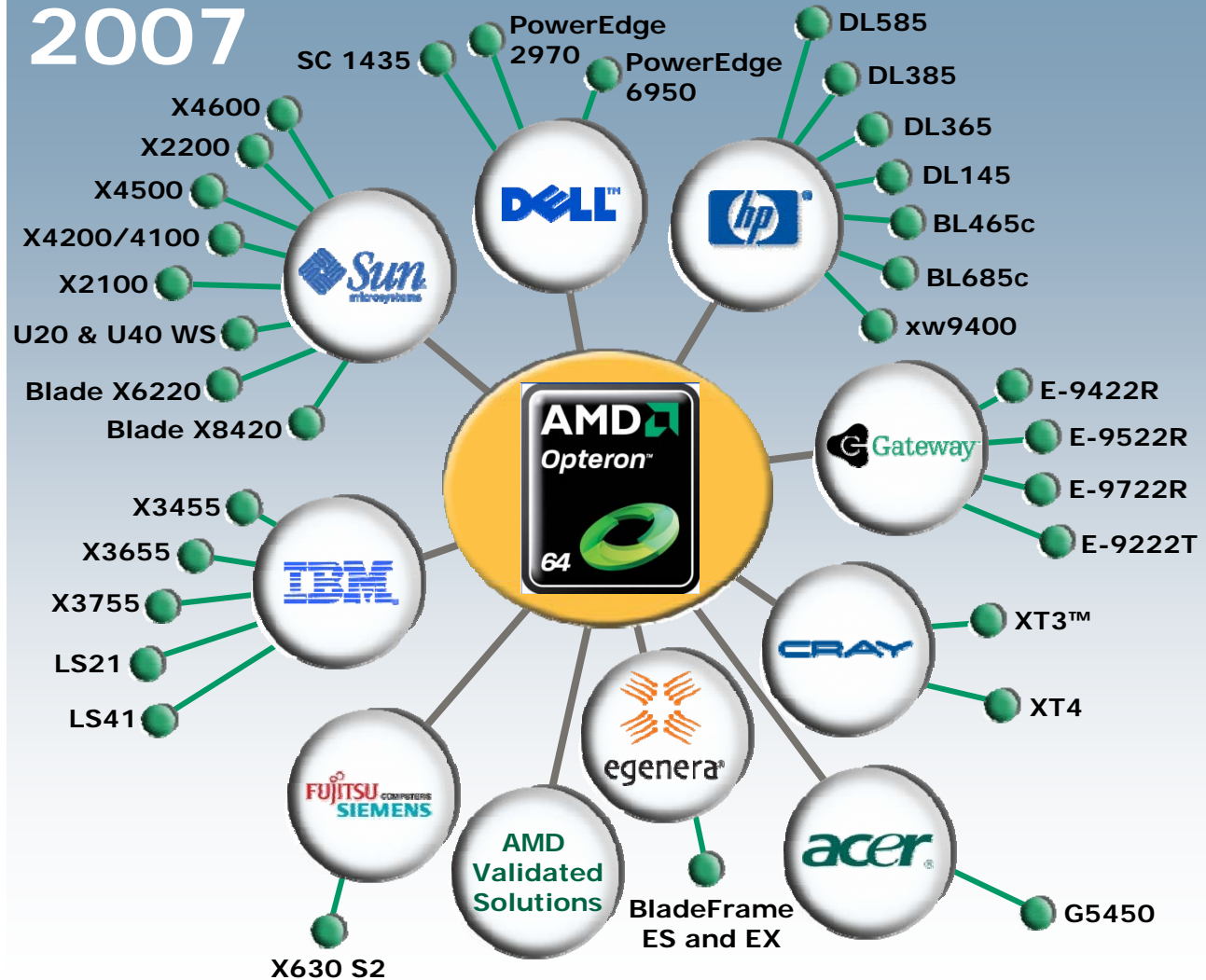


IBM eServer 325



1st Generation
AMD Opteron™

2007



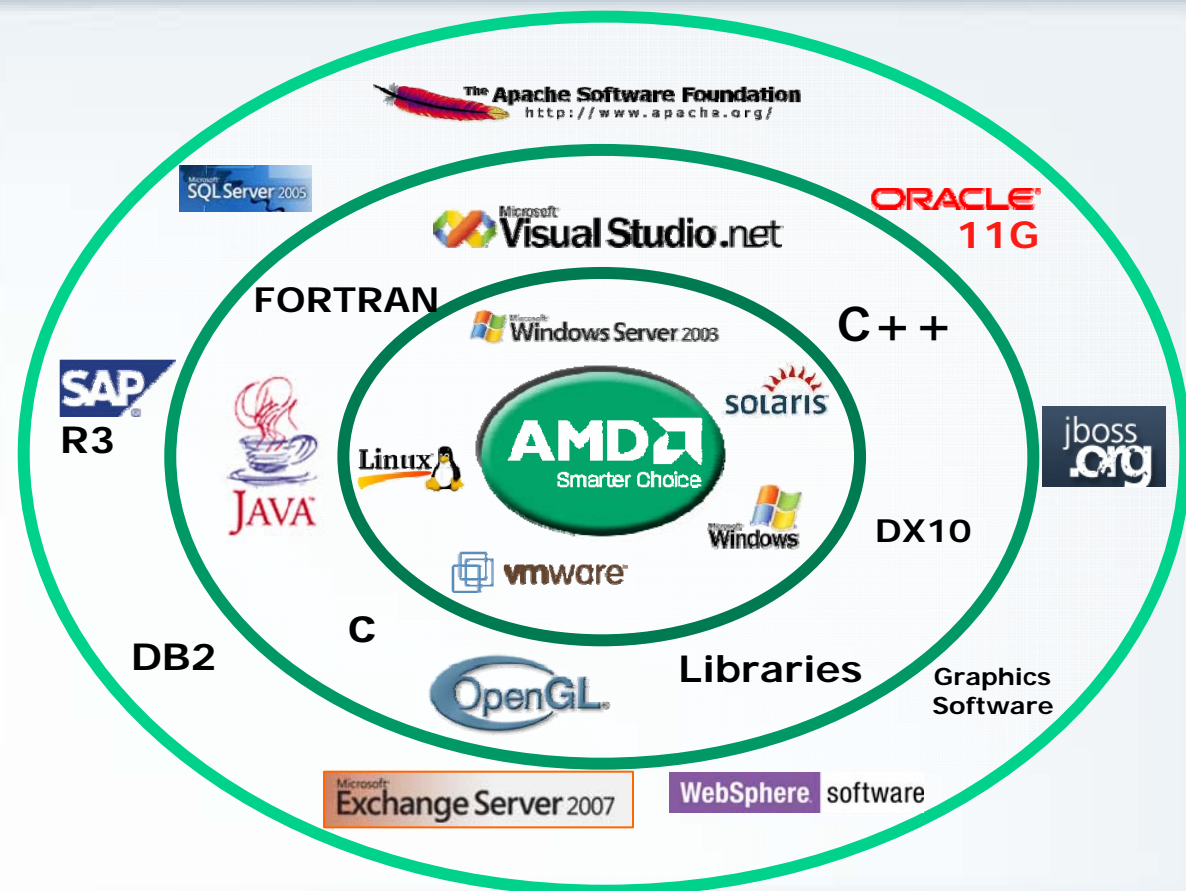
Engaging the AMD Software Ecosystem



AMD collaborates to ensure compatibility at launch...

AMD works with 300+ software and open source providers to develop compilers, tools, virtual infrastructures and OSES optimized for our new generation of processors, and optimized drivers for our new commercial graphics

~
Hundreds of software infrastructure providers now plan product roadmaps to work with AMD platforms

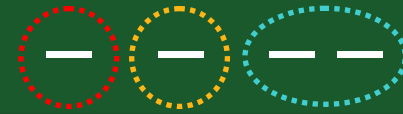


...while making it easy to optimize for native quad-core benefits

Quad-Core AMD Opteron™ Processor Model Number Overview



AMD Opteron™ Processor Model



Communicates scalability, generation and relative performance

1st digit communicates scalability — represents maximum number of processors supported

- 1-way AMD Opteron processor = 1000 Series, Model **1**xxx
- 2-way AMD Opteron processor = 2000 Series, Model **2**xxx
- 8-way AMD Opteron processor = 8000 Series, Model **8**xxx

2nd digit represents the generation of AMD Opteron processor

- Model **22**16 is 2nd generation [DDR2, Dual-Core, Socket F (1207)] & 2P capable
- Model **23**54 is 3rd generation [DDR2, Quad-Core, Socket F (1207)] & 2P capable

3rd and 4th digits communicate relative performance within generation

- For example, Model 2354 would offer
 - ✓ Better performance than a Model 2352
 - ✓ Lower performance than a Model 2358

Quad-Core AMD Opteron™ processor 23xx and 83xx Series 2H07



Performance ↑

2P Quad-Core AMD Opteron™ Processor Models and Pricing at launch

\$389	2350 (QC) 2.0GHz, 75W		
\$316	2347 (QC) 1.9GHz, 75W	\$377	2347 HE (QC) 1.9GHz, 55W
		\$255	2346 HE (QC) 1.8GHz, 55W
		\$209	2344 HE (QC) 1.7GHz, 55W

4P Quad-Core AMD Opteron™ Processor Models and Pricing at launch

\$1019	8350 (QC) 2.0GHz, 75W		
\$786	8347 (QC) 1.9GHz, 75W	\$873	8347 HE (QC) 1.9GHz, 55W
		\$698	8346 HE (QC) 1.8GHz, 55W

Quad-Core AMD Opteron processors launches with unprecedented price/performance and extends AMD value through upgradeability in current infrastructure and thermal envelopes (ACP)

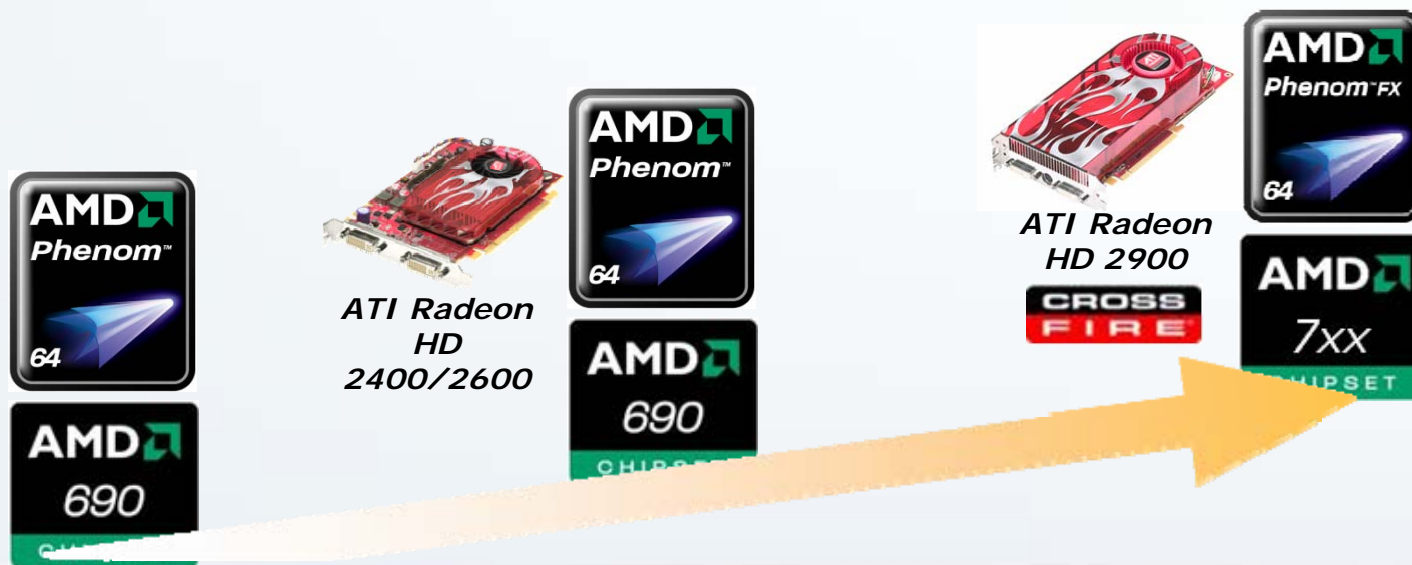
AMD Phenom™ Processors



Building off the same innovative architecture, AMD Phenom™ processors bring true quad-core solutions to the desktop market

AMD Phenom processors expected in December 2007

Create the Ultimate Visual Experience™ with an AMD platform featuring AMD Phenom processors, ATI Radeon™ HD 2000 Series graphics cards and AMD chipsets



Summary



Built for the datacenter

- HE available at launch with performance scaling
 - Investment Protection
 - Power Efficiency Innovation
 - AMD Virtualization™ technology Leadership
 - Outstanding performance
-

The market is ready for native quad-core

- More than 50 Quad-Core AMD Opteron™ processor-ready platforms in market today
 - Software ecosystem primed for the Quad-Core AMD Opteron processor
-

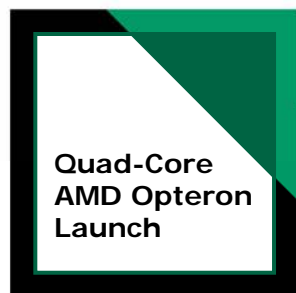
Quad-Core AMD Opteron™ is in production today

- 65nm process is strong; yields are healthy
- New architecture sets the stage for enhanced PC and digital media experience with launch of the AMD Phenom processor later this year

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Quad-Core
AMD Opteron
Launch



Backup

Details around ACP Testing

- Using “Industry Standard Power Meters”
- Logs power measurements real-time to external client
- Capture Volts, Amps, and Watts
- Using instrumented AMD internal platforms
- Measuring power at the processor



Extech MODEL 380801

- Capturing entire duration of workload
- Power measurements logged 2x a second
- Averaged power across each workload
- Use the geometric mean across all workloads



- Running commercially useful workloads
- High-utilization based loads
- Major CPU Utilization across cores



SPEC® and the benchmark names SPECcpu2006, SPECjbb2005 are registered trademarks of the Standard Performance Evaluation Corporation.

System Configurations

SPECint_rate2006

2 x Quad-Core AMD Opteron™ processors Model 2360 SE in ASUS KSFSN4-DRE motherboard, 16GB (8x2GB DDR2-667 memory), 250GB Seagate SATA disk drive, Red Hat Enterprise Linux AS Release 5 Update 1 64-bit kernel (under submission to SPEC as of 9/9/2007)

2 x Quad-Core AMD Opteron processors Model 2350 in ASUS KSFSN4-DRE motherboard, 16GB (8x2GB DDR2-667 memory), 250GB SATA disk drive, SuSE Linux Enterprise Server 10 SP1 64-bit kernel (Under submission to SPEC as of 9/9/07)

2 x AMD Opteron processors Model 2222 in FSC Celsius V840, 16GB (8x2GB DDR2-667 memory), 80 GB SATA disk drive, SuSE Linux® Enterprise Server 10 for AMD64/EM64T

<http://www.spec.org/cpu2006/results/res2007q3/cpu2006-20070802-01584.html>

2 x Xeon 5345 processors in FSC Primergy BX6200 S3, 16GB (8x2GB DDR2-667 FBDIMM memory), 36GB Seagate SAS disk drive, SuSE Linux Enterprise Server 10 (no auto parallelism)

<http://www.spec.org/cpu2006/results/res2007q3/cpu2006-20070723-01507.html>

2 x Quad-Core AMD Opteron processors Model 2350 in Tyan Thunder S4985E motherboard, 16GB (8x2GB DDR2-667 memory), 150GB GB Seagate SATA disk drive, SuSE Linux Enterprise Server 10 SP1 64-bit kernel, gcc, g++ 4.1.2 compiler (under submission to SPEC as of 9/9/2007)

2 x Xeon E5345 processors in Intel S5000PAL Server board, 16GB (8x2GB DDR2-667 FBDIMM), 250GB Seagate SATA disk drive, SuSE Linux Enterprise Server 10 SP1 64-bit kernel, gcc g++ 4.1.2 compiler (under submission to SPEC as of 9/9/2007)



System Configurations

SPECfp_rate2006

2 x Quad-Core AMD Opteron™ processors Model 2360 SE in Supermicro H8DMU+ motherboard, 16GB (8x2GB DDR2-667 memory), 250GB Seagate SATA disk drive, SuSE Linux Enterprise Server 10 SP1 64-bit kernel (under submission to SPEC as of 9/9/2007)

2 x Quad-Core AMD Opteron processors Model 2350 in ASUS KSFSN4-DRE motherboard, 16GB (8x2GB DDR2 667 memory), 250GB SATA disk drive, SuSE Linux Enterprise Server 10 SP1 64-bit kernel (Under submission to SPEC as of 9/9/07)

2 x AMD Opteron processors Model 2222 in FSC Celsius V840, 16GB (8x2GB DDR2-667 memory), 80 GB SATA disk drive, SuSE Linux® Enterprise Server 10 for AMD64/EM64T
<http://www.spec.org/cpu2006/results/res2007q3/cpu2006-20070802-01585.html>

2 x Xeon 5345 processors in Supermicro X7DB8+ motherboard, 16GB memory, 73GB 10k rpm Seagate SCSI disk drive, 64-Bit SUSE LINUX Enterprise Server 10 SP1, Kernel
<http://www.spec.org/cpu2006/results/res2007q3/cpu2006-20070821-01890.html>

2 x Quad-Core AMD Opteron processors Model 2350 in Tyan Thunder S4985E motherboard, 16GB (8x2GB DDR2-667 memory), 150GB GB Seagate SATA disk drive, SuSE Linux Enterprise Server 10 SP1 64-bit kernel, gcc, g++ 4.1.2 compiler (under submission to SPEC as of 9/9/2007)

2 x Xeon E5345 processors in Intel S5000PAL Server board, 16GB (8x2GB DDR2-667 FBDIMM), 250GB Seagate SATA disk drive, SuSE Linux Enterprise Server 10 SP1 64-bit kernel, gcc g++ 4.1.2 compiler (under submission to SPEC as of 9/9/2007)



System Configuration

SPECompM2001

2 x Quad-Core AMD Opteron™ processor Model 2350 in Tyan s4985 motherboard, 8GB (8x1GB DDR2 memory), 150GB Seagate SATA disk drive, SuSE Linux® Enterprise Server 10 SP1 64-bit (under submission to SPEC as of 9/9/2007)

2 AMD Opteron processors Model 2222 SE in Tyan Thunder n6550W motherboard, 8GB memory, 250GB SATA disk drive, SuSE Linux® Enterprise Server 9 SP3

<http://www.spec.org/omp/results/res2007q2/omp2001-20070330-00245.html>

2 x Xeon 5345 in Colfax Intel S5000 PAL server board, 16GB (8x2GB FBDIMM memory), 80GB Seagate SATA disk drive, SuSE Linux Enterprise Server 10 (2.6.16.21) (under submission to SPEC as of 9/9/2007)

Fluent 6.4.3 and LSDyna mpp 971s

2 x Quad-Core AMD Opteron processors Model 2350 in Tyan S4985E motherboard, 16GB (8x2GB DDR2-667 memory), 120GB Seagate SATA disk drive, SuSE Linux® Enterprise Server 10 SP1 init 3 (no graphics interface enabled)

2 x Xeon 5345 processors in Tyan Gt24 Transport motherboard, 16GB (8 x 2GB FBDIMM memory), 120GB Seagate SATA disk drive, SuSE Linux Enterprise Server 10 SP1, init 3 (no graphics interface enabled)



System Configurations

VMmark

2 x Quad-Core AMD Opteron Processor Model 2360 SE and 2 x AMD Opteron Processor Model 2224 SE in 2-socket platform, 32GB memory (8x4GB DDR2-667), QLA2432 (dual port PCIe 2Gb Fiber) HBA, Intel Pro10000 Dual Port PCIe 82571EB Gbit NIC, VMware ESX 3.5 experimental build 55263, VMware VMmark 1.0 release, HP MSA1500 storage system connected via Fibre 2GB HBA ports to Qlogic HBA dual port adapter. 2 x RAID0 disk array, 14x72.8GB 15k rpm Seagate SCSI disk drives, RAID0 stripe size is 128kb, 2 x 512MB raid cache controller

OLTP with IBM DB®2

4 x Quad-Core AMD Opteron processors Model 8350 in AMD Reference Server, 16GB memory, SuSE Linux Enterprise Server 10 SP1 64-bit kernel, IBM DB2® 9

4 x Dual-Core AMD Opteron processors Model 8220 in IBM x3755 server, 16GB memory, SuSE Linux Enterprise Server 10 SP1 64-bit kernel, IBM DB2® 9

